

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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OCT 26 1987

In the Matter of

Petition to Amend Part 68 of the
Commission's Rules to Include Terminal
Equipment Connected to Public Switched
Digital Service.

) Federal Communications Commission
) Office of the Secretary
) *Rm-6147*
)
)

93-268

PETITION OF THE AMERITECH OPERATING COMPANIES
FOR RULEMAKING

Pursuant to Section 1.401, et seq., of the Commission's rules the Ameritech Operating Companies^{1/} respectfully request that the Commission amend Part 68 of its rules as proposed herein to include terminal equipment connected to Public Switched Digital Service (PSDS). The proposed amendments are necessary to expand the scope of the present rules and to add specific technical specifications to protect the network from harm.

PSDS is a network service which provides a transparent switched digital network service for customer information transport. PSDS operates at 56 kilobits per second (Kbps) and will support customer information transport at any of several rates up to 56 Kbps. Although the present technologies differ in methods of operation, generic PSDS utilizes the switched network to initiate a call. The call is set up using digital facilities to allow for end-to-end digital connectivity. Dedicated digital

^{1/} The Ameritech Operating Companies are: Illinois Bell Telephone Company, Indiana Bell Telephone Company, Incorporated, Michigan Bell Telephone Company, The Ohio Bell Telephone Company, and Wisconsin Bell, Inc.

trunk groups are used to handle the call within the Ameritech Operating Companies' networks.

PSDS utilizes different technologies depending on the particular central office equipment used. The proposed amendments cover the two existing digital technologies which have been implemented by the Ameritech Operating Companies. The interface descriptions have been published for each technology.^{2/} It is anticipated that any future technologies developed for PSDS will comply with these proposed revisions to Part 68 and that the appropriate interface documentation will be made available.

The proposed amendments to Part 68 cover the generic requirements for terminal equipment used with PSDS service. Manufacturers must also consider the specific central office technology when designing terminal equipment. Recent developments have resolved the end-to-end interworking problems previously associated with the two technologies, but technology specific functionality between the terminal equipment and the serving central office switch still exists. The Ameritech Operating Companies have not proposed a unique labeling requirement since the terminal equipment which complies with the

^{2/} Bell Communications Research technical references TR-880-22135-85-01, Circuit Switched Digital Capability Network Access Interface Specifications, Issue 1, July, 1984, and TR-EOP-000277, Datapath Network Access Interface Specification, Issue 1, September, 1985, are available through Bellcore Document Distribution Service. See also Ameritech Technical Publication AM-TR-NPL-00005, Issue 1, December, 1985, Technical Interface Specifications, Datapath Network Access Interface.

proposed amendments will not harm the network regardless of the technology.

The attached appendix sets forth the proposed changes to Part 68 to cover terminal equipment used with PSDS. An addition to Section 68.2(a), Scope, is proposed in order to incorporate terminal equipment connected to PSDS within the scope of the rules. Those sections of Part 68 for which no specific amendment has been proposed will, as a result, apply as written to PSDS. The proposed amendments provide additional specific requirements for PSDS.

A new Subsection 68.2(j) is proposed to allow for the treatment of grandfathered equipment. Although PSDS is a relatively new network service, the Ameritech Operating Companies have implemented interim plans under local tariffs.^{3/} This section will allow for the continued connection of the terminal equipment which has been connected under those plans. Further, the Ameritech Operating Companies request that the Commission establish a transition period of eighteen months to allow for registration of the grandfathered equipment.

Additional definitions are proposed for inclusion in Section 68.3, including definitions of the PSDS interface and the loop simulator. Also included is Figure 68.3(m) which depicts a loop

^{3/} In addition, the Ameritech Operating Companies have recently filed a tariff for the interstate access version of the service. Ameritech Operating Companies Tariff F.C.C. No. 2, Transmittal No. 124.

simulator circuit for PSDS in the analog mode. No loop simulator is proposed for PSDS in the digital mode since the digital pulse template proposed in Section 68.308 provides the necessary protection. The proposed loop simulator circuit is illustrative of the type which must be used to properly evaluate the operation of PSDS equipment in the analog mode. However, other loop simulator mechanisms may be utilized provided they exhibit the same voltage, current and impedance characteristics.

Additional requirements are proposed for Section 68.308, Signal Power Limitations. Subsection 68.308(a) is amended to specifically add PSDS since this service directly connects to the public switched network. Amendments to Subsection 68.308(b), Voice Band Metallic Signal Power, have been proposed to provide limitations on the encoded analog content of the signals which could eventually be decoded and passed to the public switched network in analog form. This amendment is necessary to prevent excessive signal power from being introduced into the switched network when the digital signal is decoded. The Maximum Allowable Net Amplification Table in Subsection 68.308(b)(5) has been amended to include requirements applicable to PSDS in the digital mode. The accompanying note (I) provides guidance for the use of the table for both modes of operation.

A new Subsection 68.308(h)(3) is being proposed to specify the signal power limitations for PSDS in the digital mode. Included are pulse rate, pulse templates and pulse scrambler variations associated with PSDS. Because of the inherent differences in the technologies used to provide PSDS, it is

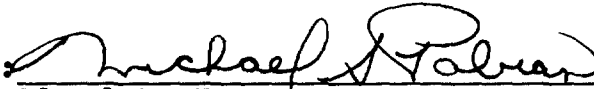
necessary to include these variations in order to cover both technologies to assure appropriate crosstalk protection. The technology specific scrambling variations assure sufficient pulse density thus preventing crosstalk in adjacent services caused by low pulse density.

Subsection 68.310(1) is amended to add a requirement to control the amount of crosstalk from pair to pair brought about by improper longitudinal balance. In addition, the present longitudinal termination value of 500 ohms is in error. The correct value is 90 ohms which is consistent with the longitudinal terminations specified for the longitudinal voltage tests for the 12 KHz to 6 MHz bands in Subsection 68.308(e)(2). Subsection 68.312(b) is amended to include PSDS in the analog mode since in that state PSDS terminal equipment is similar to any analog terminal equipment. Further, the ringer equivalence number (REN) must be calculated for that PSDS equipment capable of analog call setup.

Section 68.314, Billing Protection, is amended to extend the present billing protection requirements because PSDS terminal equipment is capable of normal usage of the public switched network in the call set-up mode. In addition, the digital PSDS mode must also comply with the two second delay requirements. Manually activated terminal equipment is excluded from this requirement because the delays inherent in manual activation will exceed the present requirement. Further, the off-hook current requirements are modified to include PSDS.

The recent resolution of the interworking problems between the central office technologies used to provide PSDS will increase the attractiveness of this service. Adoption of these proposed changes to Part 68 will provide customers with the benefits of the Commission's registration interconnection program while assuring that the network is protected. The Ameritech Operating Companies urge the Commission to act quickly on this request.

Respectfully submitted,

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APPENDIX
PROPOSED REVISIONS
TO
PART 68
FOR TERMINAL EQUIPMENT CONNECTED TO
PUBLIC SWITCHED DIGITAL
SERVICE
(PSDS)

Changes proposed herein by the Ameritech Operating Companies are shown in this Appendix as amendments to the existing Part 68 Rules. Changes are shown in the following manner:

- (1) Wording to be deleted is lined out
e.g., ~~words words~~
or by indicating

1
1
(delete)
1
1

- (2) Wording to be added is underlined
i.e., words words
or by indicating

1
1
(new)
1
1

Underlining presently included in the Rules for heading and emphasis has been deleted for clarity.

- (3) The designation

* * *

indicates that the text material in the existing or proposed Part 68 Rules has been skipped but is unchanged.

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Section 68.2(a) Scope

PROPOSED RULE

- (a) General. Except as provided for Paragraphs (b), (c), (d), (e), (f), (g), (h), (i) and (j) the rules and regulations in this Part apply to the direct connection:

* * *

- (new) (9) all terminal equipment to Public Switched Digital
1 Service (PSDS).

RATIONALE

The propose subparagraph (9) expands the Scope of Part 68 to include connection of terminal equipment to Public Switched Digital Service (PSDS). This service incorporates varying technologies, i.e., alternate analog and digital only, at different bit rates.

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Federal Communications Commission
Office of the SecretarySection 68.2(j) ScopePROPOSED RULE

- 1 (j) Grandfathered terminal equipment for connection to PSDS:
- 1
- 1 (1) Terminal equipment, including its premises wiring and
- 1 protective apparatus (if any) directly connected to
- 1 PSDS on (grandfather eligibility date), may remain
- 1 connected to PSDS for life without registration, unless
- 1 subsequently modified.
- 1
- (new) (2) New installation of terminal equipment, including
- 1 premises wiring and protective apparatus (if any) may
- 1 be installed up to (register only date) without
- 1 registration of any terminal equipment involved,
- 1 provided that the terminal equipment is of a type
- 1 directly connected to PSDS as of (grandfather
- 1 eligibility date). This terminal equipment may remain
- 1 connected and be reconnected to PSDS for life without
- 1 registration, unless subsequently modified.

RATIONALE

Although PSDS is a new service, the implementation of tariffed interim plans for the connection of eligible equipment prior to the adoption of these proposed revisions to Part 68 makes it appropriate to allow for a grandfathering and transition period to accommodate this terminal equipment already connected to PSDS. Past Commission actions have regularly allowed an eighteen (18) month period for these purposes.

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Section 68.3 Definitions

PROPOSED RULE

1 Public Switched Digital Service Interface: A two wire
1 interface between terminal equipment and the
1 telecommunications service provided by PSDS.
(new) The tip and ring leads shall be treated as telephone
1 connections for the purpose of fulfilling registration
1 conditions.

RATIONALE

The interface leads for PSDS terminal equipment are identified so the appropriate registration requirements can be applied.

Section 68.3 Definitions

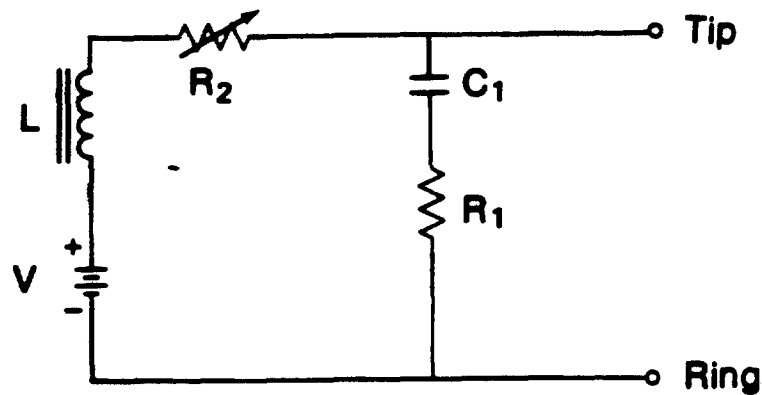
PROPOSED RULE

1 PSDS Loop Simulator Circuit: A circuit simulating the
1 network side of the 2-wire telephone connection that is
1 used for testing terminal equipment to be connected to PSDS.
1 Figure 68.3 (m) shows the type of circuit required. Other
1 implementations may be used provided that the same dc voltage
1 and current characteristics and ac impedance characteristics
(new) will be presented to the equipment under test as are
1 presented in the illustrated circuit. When used, the
1 simulator should be operated over the entire range of loop
1 resistances, and with the indicated voltage limits and
1 polarities. Whenever the loop current is changed,
1 sufficient time shall be allowed for the current to reach
1 a steady-state condition before continuing testing.

RATIONALE

The proposed definition of the PSDS loop simulator circuit is provided since the electrical parameters presented to terminal equipment connected to PSDS differ from those of an ordinary telephone connection.

Terminal equipment must be tested in the analog mode of operation, as indicated in Figure 68.3 (m). The proposed Figure 68.3 (m) is illustrative of the type of circuit which must be employed for the analog mode. However, other implementation may be provided as long as the voltage, current and impedance characteristics are the same. The digital mode does not require a loop simulator since the signal power template provided in Subsection 68.308(h)(3)(ii) provides the necessary protection.



$L \geq 10H$ (Resistance = R_L)

$R_1 = 600 \Omega \pm 1\%$

$C_1 = 500 \mu F, -10\%, +50\%$

(New)

TEST CONDITIONS FOR ANALOG MODE

V (Volts)		$R_2 + R_L$ (Ohms)
Min	Max	Continuously Variable
36	46	610 To 1510

Fig. 68.3 ()

SIMULATOR CIRCUIT FOR PSDS IN ANALOG MODE

Section 68.308(a) Signal Power Limitations

PROPOSED RULE

(a) General

Limitation on signal power shall be met at the interface for all 2-wire network ports, tip and ring conductors of all connections to PSDS, and, where applicable to offered services, both transmit and receive pairs of all 4-wire network ports. Signal power measurement shall be made using terminations as specified in each of the following limitations. The transmit and receive pairs of 4-wire network ports shall be measured with the pair not under test connected to a termination equivalent to that specified for the pair under test. Through gain limitations apply only in the direction of transmission toward the network.

RATIONALE

The signal power limitation is revised to apply to terminal equipment connecting to the tip and ring leads of PSDS since terminal equipment connected PSDS is directly connected to the public switched telephone network.

Section 68.308 Signal Power Limitations

PROPOSED RULE

(b) Voiceband Metallic Signal Power

(1) Limitations at the Interface Signals not intended for Network Control Signaling

* * *

1 (viii) For PSDS terminal equipment when in the digital
1 mode of transmission, the maximum equivalent
1 power of any encoded analog signal (other than
(new) live voice) shall not exceed -12 dBm over any
1 3-second time interval. The equivalent analog
1 shall be derived by a zero level decoder
1 located at the network interface to PSDS
1 facilities.

(2) Limitations of Internal Signal Sources Primarily Intended for Network Control Signaling, Contained in Voice and Data Equipment.

* * *

1 (iii) For PSDS terminal equipment, when in the
1 digital mode of transmission, the maximum
1 equivalent power of any encoded analog signal
(new) shall not exceed -3 dBm when averaged over a
1 3-second time interval. The equivalent analog
1 signal shall be derived by a zero level decoder
1 located at the network interface to PSDS
1 facilities.

RATIONALE

The proposed additions to Section 68.308(b) are needed to limit the encoded analog content of the digital signal of the PSDS terminal equipment to prevent excessive signal power from being transmitted into the voiceband analog network if the signal is decoded.

Section 68.308 Signal Power Limitations

PROPOSED RULE

(b) Voiceband Metallic Signal Power

* * *

- (5) Registered One Port and Multiport Terminal Equipment and Protective Circuitry with Provision for Through-Transmission

from Ports to Other Equipment which is Separately Registered for the Public Switched Network, or Ports to other Network Interfaces.

* * *

(TABLE ON FOLLOWING PAGE)

- | | |
|-------|--|
| 1 | (I) The designation PSDS in the Table refers to the |
| 1 | requirement for terminal equipment connected to PSDS while |
| (new) | such equipment is in the digital mode of transmission. |
| 1 | When in the analog mode of transmission, the requirements |
| 1 | for connection to the public switched network apply. |

RATIONALE

A revision to the table for maximum allowable net amplification between ports has been proposed to include requirements applicable to PSDS. The accompanying note (I) states the appropriate requirements for use of the table for the analog and digital modes of transmission of PSDS.

Section 68.308 Signal Power LimitationsPROPOSED RULE

- (h) Interference Limitations for Transmission of Bipolar Signals over Digital Services

* * *

1 (3) Limitations on Terminal Equipment Connecting to PSDS

1 (i) Pulse Repetition Rate

1 The pulse repetition rate shall be a maximum of 144,000
1 pulses per second or 160,000 pulses per second within + 5
1 pulses per second depending on the technology utilized by
1 the telephone company in the serving central office.

1 (ii) Template for Maximum Output Pulse

1 When applied to a 135 ohm resistor, the instantaneous
1 amplitude of the largest isolated output pulse obtainable
1 from the registered terminal equipment shall fall within the
1 template of Table IV A or Table IV B depending on the
1 technology utilized by the telephone in the serving central
1 office. Table IV A is associated with the 144,000 pulses
1 per second limitation stated in subsection (i) above.
1 Table IV B applies to 160,000 pulses per second limitation
1 stated in subsection (i) above. The limiting pulse template
1 shall be defined by passing an ideal 50% duty cycle
1 rectangular pulse with the amplitude/pulse rate
1 characteristics of Table IV A or Table IV B through a 1 pole
1 lowpass filter with a 3dB frequency of 260 kHz.

(new)

1 TABLE IV A

1 Pulse Height	2.2 to 3.0 volts
1 Pulse Width (at 50% points)	3472.2 + 150 nsec.
1 Maximum rise or fall time	100 nsec.
1 (from 10% to 90% points)	

1 TABLE IV B

1 Pulse Height	2.3 volts
1 Pulse Width (at 50% points)	3125 + 150 nsec.
1 Maximum rise or fall time	1.2 microsec.
1 (from 10% to 90% points)	+ .2 microsec.

1 (iii) The registered terminal equipment shall be capable of
1 producing one of the two following patterns of scrambled data
1 bursts. The applicable scrambler pattern is dependent on the
1 technology utilized by the telephone company in the serving
1 central office.

(a) A Scrambler

Scrambled data bursts shall be produced by applying exclusive OR logic to the sum of the data and spare bits of the burst and each of eight predefined masks. The scrambling masks are a pseudo-random binary sequence, 196 bits in length. The 8 scrambling masks are formed from the sequence of 1568 bits generated by the recursion equation:

$$x(n) = X(n-2) \oplus x(n-11)$$

where \oplus represents the exclusive OR operation. The initial conditions for the recursion equation are:

$$\begin{array}{lll} x(n-1) = 1 & x(n-5) = 0 & x(n-9) = 1 \\ x(n-2) = 0 & x(n-6) = 1 & x(n-10) = 0 \\ x(n-3) = 0 & x(n-7) = 1 & x(n-11) = 1 \\ x(n-4) = 0 & x(n-8) = 0 & \end{array}$$

(b) B Scrambler

Scrambled data bursts shall be produced by a scrambler that is frame synchronized with start and stop bits. An exclusive OR with a pseudo-random bit pattern is applied to 72 bits. This applies to both the transmitted data and the received data. Prior to the data being coded into bipolar form and being transmitted, it is fed into one of the inputs of a two input exclusive OR gate with the bit pattern fed into the second input coming from the pseudo-random generator. The start and stop bits are not passed through the scrambler or descrambler. The bit pattern the generator creates is given in Table V.

Table V

Bit Count	Value	Bit Count	Value
0	1	36	1
1	0	37	0
2	1	38	0
3	1	39	1
4	0	40	1
5	1	41	0
6	1	42	1
7	0	43	1
8	0	44	1
9	0	45	0
10	1	46	1
11	0	47	0
12	1	48	0
13	0	49	0
14	0	50	1
15	0	51	0
16	0		

Appendix Page 13

	Bit Count	Value	Bit Count	Value
1				
1				
1	17	0	52	0
1	18	1	53	0
1	19	1	54	1
1	20	1	55	1
1	21	0	56	0
1	22	1	57	1
1	23	1	58	0
1	24	0	59	1
1	25	1	60	1
1	26	0	61	0
(new)	27	0	62	0
1	28	1	63	1
1	29	1	64	1
1	30	1	65	1
1	31	1	66	0
1	32	0	67	0
1	33	0	68	1
1	34	0	69	1
1	35	0	70	0
			71	0

RATIONALE

The proposed requirements on the digital signals of terminal equipment connecting to PSDS are needed to control the level of crosstalk interference into analog carriers in adjacent binder groups, or into other digital services.

The scrambling of the digital signal prevents the generation of discrete frequency components, thus ensuring the sufficient density of pulses needed for the timing recovery and to prevent crosstalk interference in adjacent systems.

Section 68.310 Longitudinal Balance Limitations

PROPOSED RULE

- (1) The maximum balance requirements for registered terminal equipment connected to digital services specified in Figure 68.310(k) shall be equaled or exceeded for the range of frequencies applicable for the equipment under test and under all reasonable conditions of the application of earth ground to the equipment. All such terminal equipment shall have a longitudinal balance in the acceptable regions of Figure 68.310(k). The metallic termination used for the longitudinal balance measurements for 2.4, 4.8, 9.6, and 56 kpbs shall be 1035 Ohms plus or minus one percent and for 1.544 Mbps shall be 100 Ohms plus or minus one percent. The metallic termination used for the longitudinal balance measurements for PSDS shall be 135 Ohms plus or minus one percent. The longitudinal termination for these measurements shall be ~~500~~ 90 Ohms in all cases.

RATIONALE

The proposed longitudinal balance requirement for terminal equipment connected to PSDS is needed to control the amount of crosstalk from pair to pair in the cables used for PSDS. The longitudinal balance requirements are extended over a wide frequency range to reflect the effect of the higher frequencies used by PSDS. The original 500 Ohm longitudinal termination value is in error and should be changed to reflect the correct value of 90 Ohms. The longitudinal termination applies to subrate, 1.544 Mbps and PSDS digital services.

Section 68.312 On-Hook Impedance Limitations

PROPOSED RULE

- (b) Limitations on individual equipment intended for operation on loop-start telephone facilities, including PSDS in the analog mode:

* * *

RATIONALE

The proposed rule amendment is necessary for terminal equipment connected to PSDS because the terminal equipment has access to the public switched network during its call setup mode. The determination of a ringer equivalence number through the methods of Subsection 68.312(d) is also required.

Section 68.314 Billing Protection

PROPOSED RULE

- (a) Call duration requirements on data equipment connected to the Public Switched Network or to Tie Trunks, or to Private Lines that access the Public Switched Network, or PSDS.

* * *

(3) Equipment Connected to PSDS:

- 1 When an incoming PSDS call is answered, both transmission and
1 reception of data shall be prevented for at least 2 seconds after
1 the answering terminal equipment transfers to the off-hook
(new) condition. Fixed sequences of signals transmitted and/or received
1 as specified in 314(a)(2) (i thru iv) are excluded. These
1 requirements do not apply to equipment that uses manually
1 activated circuitry to transfer to the off-hook state and also uses
1 manually activated circuitry to request the switch from analog mode
1 to digital mode.

- (b) Analog and digital equipment loop current requirements for equipment connected to the Public Switched Network, or to Tie Trunks, or to Private Lines that access the Public Switched Network, or PSDS.

* * *

- (c) Analog and digital equipment loop current requirement for equipment connected to the Public Switched Network, or PSDS.

* * *

- 1
1 Terminal equipment connected to PSDS shall comply with the
1 requirements of (1) and (2) above, when it enters the analog mode
(new) in response to ringing to (called party condition), except that the
1 time restriction shall be at least two seconds (instead of five
1 seconds).

(d) Signaling Interference Requirements

- 1 (3) Terminal equipment connected to PSDS shall
1 not deliver digital signals to the telephone network with
(new) encoded analog energy in the 2450 to 2750 Hertz band unless
1 at least an equal amount of encoded analog energy is present
1 in the 800 to 2450 Hertz band.

RATIONALE

The proposed revisions to this section apply the present billing protection requirements to PSDS. All the present requirements are needed for the terminal equipment when operating in the call set-up or analog mode, since it is capable of normal usage of the public switched telephone network. For communication in the digital mode, a delay of transmitted signals is not needed if manually activated circuitry is used, because delays in the network required to switch modes and effect equalization will add to the manual delays and provide at least a two second delay in the transmission and reception of digital signals. The off-hook current limitations of (c) are modified for PSDS, to reflect the normal operation of the termination serving offices. Proposed subsection (d)(3) extends the signalling systems interference requirements to PSDS.

As indicated in the table

below, the requirements for PSDS

are as follows:
